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INNOVATIONS IN MILITARY ORGANIZATIONS

by

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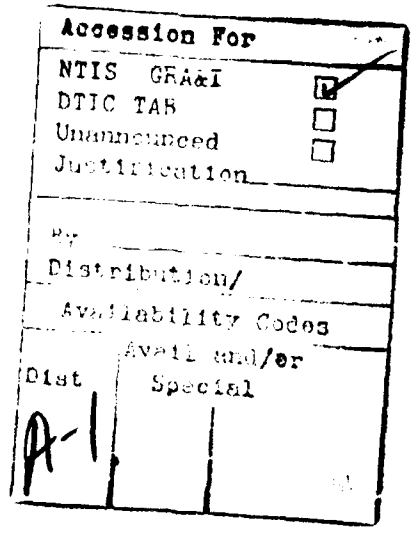
ABSTRACT

This research was undertaken to study the innovation process in organizations. The main objective was to provide insight on the dynamics of the innovation process in organizations which will help us construct a new perspective and framework in managing innovations within organizations.

The interaction between technology and innovations, management of technological innovations, and innovation processes specific to the public organizations is explored. The hypotheses on innovation processes in organizations are developed. The evidence supporting these hypotheses are presented by observations on the innovation processes in the U.S. Department of Defense.

The thesis concluded by presenting conclusions and suggestions for further research.



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I. INTRODUCTION

A. GENERAL

> "Diffusion research is thus emerging as a single, integrated body of concepts and generalizations, even though the investigations are conducted by researchers in several scientific disciplines."
>
> Everett M. Rogers with F. Floyd Shoemaker (1971, p. 47), *Communication of Innovations: A Cross-Cultural Approach*.

> "ONE REASON WHY THERE IS SO MUCH INTEREST in the diffusion of innovations is because getting a new idea adopted, even when it has obvious advantages, is often very difficult. There is a wide gap in many fields, between what is known and what is actually put into use. Many innovations require a lengthy period, often of some years, from the time when they become available to the time they are widely used. Therefore, a common problem for many individuals and organizations is how to speed up the rate of diffusion of an innovation." [Ref. 1:p. 1]

This research is undertaken to examine the innovation process in organizations. There has been a greatly increasing interest on this area in the past decade. By its very nature, the research on the innovation process in organizations significantly differ from the classical diffusion research and presents an important intellectual challenge to the researchers. It is by no means possible to cover every conceivable aspect of this subject within the amount of time and effort spent on this thesis. We mainly focused on the shortcomings of the past research in the area, as explained in the methodology section, and provided a different perspective

that would be integrated in future research. We believe that we developed a useful conceptual framework to explain some of the dynamics of the diffusion process, and further research questions that would determine the path of future researches on this area.

B. TERMINOLOGY

Terminology used throughout this thesis is not different than the general terminology of diffusion research. But it is a necessary precondition to make clear the meanings of the terms as we use to establish a healthful communication environment.

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. There are four main elements in this definition: *Innovation, communication channels, social system,* and *time*.

Innovation is an idea, practice, or object that is perceived as new. Most of the new ideas, considered as innovations, are closely related with technological developments. We often use "innovation" and "technology" as synonyms. A technology is a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome. A technology has two components: (1) a hardware aspect, material or physical objects, and (2) a software aspect, consisting of the

information base for the tool. [Ref. 1:p. 12] Following is a very short list of the areas of interest in diffusion research: the characteristics of innovations, how they are generated and developed, the decision process for adoption, and the differences between the innovations.

Communication is the process by which participants create and share information with one another in order to reach a mutual understanding. The essence of the diffusion process is the information exchange by which one individual communicates a new idea to one or several others. The process involves: (1) an innovation, (2) an individual or other unit of adoption that has the knowledge of, or experience with using, the innovation, (3) another individual or other unit that does not yet have knowledge of the innovation, and (4) a communication channel connecting the two units. The communication channel is the means by which messages get from one individual to another. [Ref. 1:p. 17] In the case of organizations, the main focus is on the nature of the information-exchange relationship between the different parts of the organization and how it determines the effect of transfer.

A social system is defined as a set of interrelated units that are engaged in joint problem solving in order to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems. The social system constitutes a boundary within which an innovation diffuses. [Ref.1:p. 24] The effects

of social structure, and norms on the diffusion process have particular importance on diffusion research.

Time is involved in the innovation process. The time frames of innovations and how they differ, and why are the important questions in diffusion research.

C. OBJECTIVES

This thesis explores the various concepts of innovation process. The interaction between technology and innovations, management of technological innovations, and innovation processes specific to the public organizations are explored.

The main objective is to provide insight on the dynamics of the innovation process in organizations, which will help us construct a new perspective and framework in managing innovations within organizations.

D. RESEARCH QUESTIONS

In pursuing the objectives of this study, the following research question was posed: What are the main determinants of the innovation process in public organizations?

In addressing this question and to explore the background of the issue, the following subsidiary research questions were established:

1. What are the characteristics of an innovation process?
2. What is the importance of the relationship between technology and innovations?

3. What are the considerations in managing technological innovations?

4. What are the driving forces for innovations?

5. What are the role of organizational environment in the innovation process?

E. RESEARCH METHODOLOGY

In establishing research methodology, we did an extensive study on the approaches of previous research in the area. Preliminary research included a review of past diffusion research. In this phase we also reviewed the criticism of these research and determined the major shortcomings and biases. We identified the following principles to integrate our research approach:

- Emphasis on broader context in which an innovation diffuses. This wider scope helps illuminate the broader system in which the diffusion process occurs. There is much more to diffusion than just variables narrowly related to an innovation's rate of adoption.

- Recognition of the importance of the "why" question rather than "how." Investigation of the motivations for innovations and their adoption is much more important than examining how the process actually takes place.

- Avoiding a pro-innovation bias. There is no good or bad innovation, but all innovations have certain perceived consequences which affect their diffusion. The examination of rejected, discontinued or reinvented innovations provides us with an insight on the process sometimes more than the successful innovations.

In this phase, we also determined the actual approach we would take in examining the innovation process. In the light of the principles stated above, we decided on a conceptual approach rather than a statistical process. We decided to deal

with the issue first in general terms, and then to apply our findings on a particular public organization. As a real life example we chose the Department of Defense (DoD). Focusing on one organization, provides more reliable data and permits greater insight in tracing the nature of the innovation process in an organization. Although there is less basis for generalization of the research results, this approach was the most practical one within the scope of this thesis.

The next phase of the research conducted was a literature research on the diffusion of innovations and on the organization of DoD. The research is limited to the unclassified U.S. publications or foreign publications and documents which are available at the Naval Postgraduate School library.

F. ORGANIZATION OF THE RESEARCH

The research divided into six chapters. In this chapter, the objectives of the research have been set forth, the direction of the effort identified and methodologies for material and analysis presented.

Chapter II provides a theoretical review of the concept of innovation and its interaction with technology.

Chapter III mainly focuses on strategic management of technology and innovations.

Chapter IV discusses the innovation processes in organizations and presents the hypotheses regarding to this process.

Chapter V presents observations on the innovation process in DoD and compares them with the predictions of the hypotheses developed in chapter IV.

Chapter VI sets forth conclusions and future research questions.

This study is developed as a joint thesis by two students. Although introduction and conclusion are written jointly, chapter II and III are written by A. Can CEVIK, and chapter IV and V by Seckin DURMAZ.

II. INNOVATION AND TECHNOLOGY

Although most schools of thought believe that innovation and technology should be regarded differently and discussed individually, we believe that these two ideas interact with each other very closely. In fact whenever we discuss one idea we also speak about the other; we often use "**technology**" and "**innovation**" as synonyms.

We will begin by defining each of the two ideas and then describe their interaction.

A. INNOVATION

The innovation process is generally described as an evolutionary process because it is derived through series of actions which in effect deliver an invention or idea to its initial acceptance and use. According to Roger's definition,

> "An **innovation** is an idea, practice, or object perceived as new by an individual or other unit of adoption. If the idea seems new to the individual, it is an innovation." [Ref. 1]

The principal interest here is the process of taking a concept, invention, or idea and developing a useful product, process or technique, which gains initial acceptance in the user community. At this point we should consider that acceptance or adoption of all innovations is not necessarily desirable. One innovation can be very desirable to some user

groups but it may be undesirable to other groups or individuals. For example using robots in production saves time provides more accuracy and increases the profit, so it is very desirable to the factory owners. On the other side it is not desirable to the employees which are replaced by robots, because more robots mean fewer jobs and smaller pay checks and more unemployment.

Innovation is not a technical term; Drucker [Ref. 2:p. 785] states that innovation is an economic and social term. Its criterion is neither science nor technology, but a change in the economic or social environment, a change in the behavior of people as consumers or producers. Innovation creates new wealth or potential action rather than new knowledge. Therefore, the bulk of innovative efforts must come from places that control manpower and money needed for development and marketing, that is, from the existing large aggregates of trained manpower and disposable money-existing businesses and existing public-service institutions. The sources of opportunity for innovation suggested by Drucker [Ref. 3:p. 68] are:

1. Unexpected occurrences,
2. Incongruities,
3. Process needs,
4. Industry and market changes,
5. Demographic changes,

6. Changes in perception,

7. New knowledge,

Marquis [Ref. 4] defined the types of innovations as follows:

- Radical innovations: ideas that have impact on or cause significant changes in the whole industry.
- Incremental innovations: small ideas that have importance in terms of improving products, processes, and services.
- System innovations: ideas that require several resources and many labor-years to accomplish. Communications networks and satellite operations are good examples of system innovations.

Here we would like to mention the four major features evident in a technologically innovative environment as presented by Edosomwan. In most advanced economies, four features are evident:

1. Dynamic management approaches to labor, money, materials, and other natural resources.
2. The need to be innovative in order to be competitive.
3. The use of imaginative financing methods to provide the financial resources for innovative projects.
4. A strong awareness that the rapid growth and obsolescence of technology call for an ongoing innovative process in a dynamic environment.

It is important that innovations be initiated not just through the generation of an idea or invention, but also stimulated from the recognition of a need or technical opportunity. In fact, recent research shows that most successful innovations arise from need recognition rather than

idea generation or intervention. That is, demand-pull rather than technology-push was found to be a stimulus in most cases of successful innovation. This does not imply that inventions and idea generation are not important in the overall innovation process.

The Innovation Process Model (IPM) presented by Betz [Ref. 5] states that innovation begins with a new idea that is influenced by some event in either the external or internal operating environment. The operating environment events stimulate the memory, intelligence, and experience of the innovator; this stimulation leads to the recognition and formulation of both the technical feasibility and the demand for a new idea. The innovator then embarks on problem solving, data gathering, and data manipulation to translate the idea into an invention. In the development and testing stage, the innovator tests two things: the feasibility of the idea in production, and the acceptability of the end product in the marketplace. The final stage in the IPM process involves the diffusion of the end product in the marketplace. IPM follows a logical reasoning process that includes these five:

1. Logical organization of a basic idea into meaningful experience.
2. Refining the idea of clarity.
3. Solving potential problems related to the idea and searching for feasible solutions.
4. Revising the idea based on constraints, new input, and other suggestions and embarking on full development and testing of idea components.

5. Full-scale implementation of the idea in the marketplace.

Also Rogers [Ref. 1] gives us another process ," **Innovation-Development Process.**" The Innovation-Development Process consists of all decisions, activities and their impacts that occur from recognition of a need or problem, through research, development, and commercialization of an innovation, through diffusion and adoption of the innovation by users, to its consequences. Rogers gives us these main steps for his process;

1. **Recognition of a Problem or Need**: According to this step the process begins firstly by recognition of a need or a problem. This recognition leads to research and to activities which are designated to create an innovation to solve the problem or need.

2. **Basic and Applied Research**: The knowledge base for technology usually derives from basic research. This creates an origin for the advancement of scientific information that is not applied to practical problem. But applied research includes scientific research that aims to solve practical problems. According to Rogers applied researchers are the main users of basic research. thus an invention comes from this order;

3. **Development**: The development process is to use the idea to meet the needs of a group of potential adopters. Actually this process concentrates on developing the production and the life cycle of the product. This phase also affects the nature of the innovation.

4. **Commercialization**: This step is the production. manufacturing, marketing, and distribution of a product that comes from an innovation.

5. **Diffusion and Adoption**: This is the most important step in the whole process. Because at this point there are two contradictions. At one side there are problems or needs which are supposed to produce the solutions as soon as

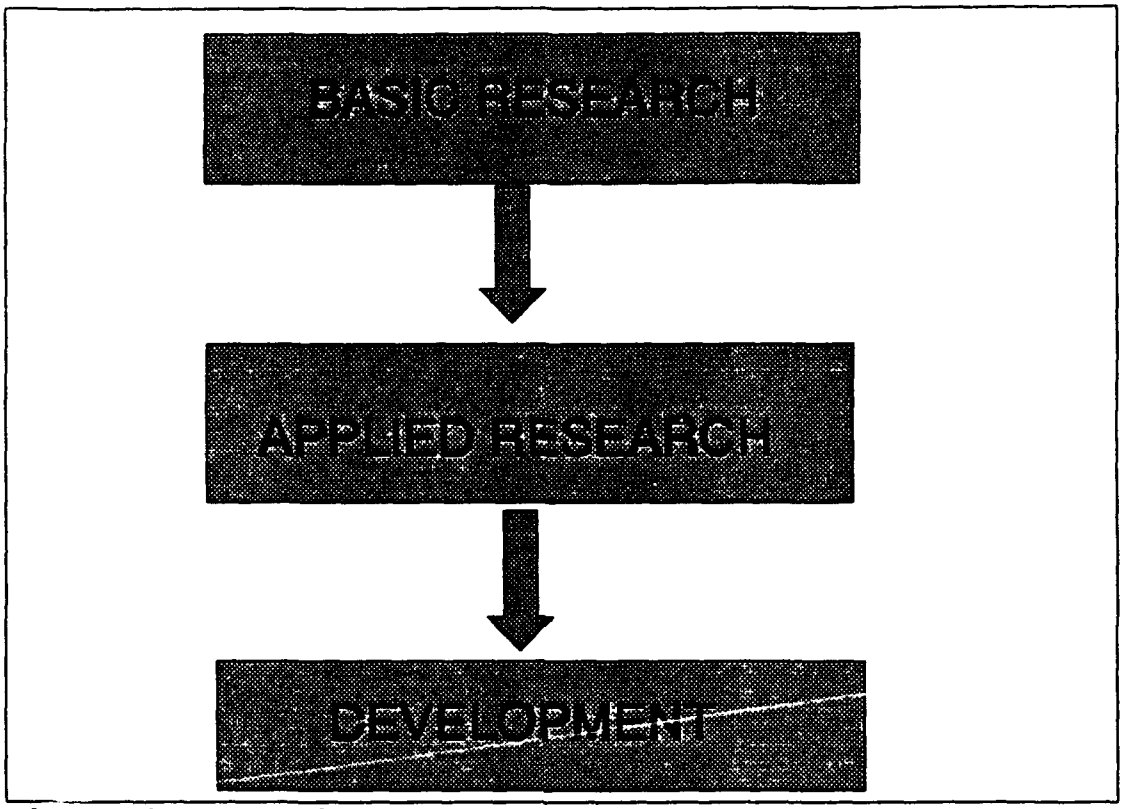

Figure 1 Innovation Development Process

possible. On the other hand, scientists tend to be cautious when the time comes to translate their information into practice.

6. **Consequences**: This is the final step of innovation-development process of Rogers.

Here the important thing is whether a solution is found to the problem/need or not by the innovation. Often new problems and needs arise by the introduction of an innovation.

At this point we also should remember that, although need recognition is found to be a major stimulus for first conception in most successful innovations, many of these may not have succeeded without the benefit of inventions and ideas developed during the innovative period. This is mainly because

innovation is subjected to many internal influences, which are not controllable by the innovator. Consequently, the innovation process develops an evolutionary nature, which is not often responsive to strict management and control. This is evidenced by the relative distinction in time span between first conception and first the realization of successful innovation.

B. TECHNOLOGY

At the beginning of this chapter we said that " Innovation comes from a series of actions, which in effect deliver an invention or an idea to its initial acceptance." Here we can pass to a broad definition for technology such as technology is a special, huge body of information that can be used to reach a goal, to compensate a need, or to accomplish a mission. Hawthorne [Ref. 6:p. 7] defines technology as "The development and application of knowledge and experience in the production and the use of goods and associated services. " or "The application of knowledge over the complete spectrum." We want to stress the application of knowledge. Because technological developments do not just happen; they result from the deliberate efforts, aroused by social and economic forces, to find a new way of satisfying perceived needs.

We think that there is no natural law by which technological developments are assured. Although there are

many generalizations made by some researchers but they are not certain rules.

According to John Naisbitt, author of Megatrends [Ref. 7], technology generally emerges through three stages:

1. First, technology follows the path of least resistance. It is used in applications that do not compete with existing products it is used to provide advantages that are not questionable, thus causing little resistance from vested interests. Here we will again consider the innovation-development process. As we stated earlier the first step of the whole process is the problem/need recognition. Here we can say that the least resistant path is the problems or needs that are not controversial. Everybody agrees on the same thing. The use of robots in hazardous situations such as automotive paint spraying and combat deep sea diving, for example, are good cases in point.

2. Technology is then used to substitute for existing ways of doing things. Here the point is the need recognition may be controversial to some user groups. Because some user groups can't afford these kinds of innovations that may not create a crucial difference in the social life. This is the "better, faster, cheaper" stage. While there is clear value to the customer at this point, the technology does not typically create broad social changes. The accounting era of data processing and the early use of word processors are typical examples.

3. In the third phase, technology is used in a truly innovative manner, providing goods and services that are new, solving problems that could not be addressed before, satisfying previously unfulfilled needs and have to do in general with the way people live their lives. The telephone, radio, and television are classic examples. But equally dramatic are the electronic spreadsheet, which has forever changed the manner in which people in business work with numbers, and solid-modeling engineering workstations, which have radically altered the design process.

Most studies indicate the evolution of technology in four phases;

- Scientific discovery to invention.
- Invention to innovation.
- Diffusion through the market.
- Decline from maximum market penetration to total outdating.

According to Sumanth [Ref. 8], today's technologies are changing very rapidly, and the challenge becomes even greater as enterprises have to keep tempo with such technologies at the product and production process level. We can give the nowadays' famous example; the personal computer. Just about 10 years ago, when the first personal computer (TR-80 by Tandy Corp.) was marketed, the product technology offered a capability of an 8K random access memory (RAM). Today, an IBM PS/2 Model 80 can come with as much as 16,000K RAM (2000 times more), with a maximum disk storage of 230 MBytes. In fact some other companies passed even these limits. Today's surface mounted technology has drastically changed product design considerations compared to even three years ago. The IBM PC XT model, which was introduced in 1986, is no longer produced as the new PS/2 systems coming into the market. The average shelf-life of personal computers is now about two years. If we think about the phases explained above, we can easily see the dynamics of change for personal computers. When the product is designed, pilot-tested, sourced out to the vendors for parts, assembled, and marketed with a decent advertising program, the competition is already in the

''cloning mode'' ready to threaten the new product entries. Global satellite communications have made it possible to access vital information on a worldwide basis at an exceptional speed.

Recent works by the New York Stock Exchange (1984), Betz [Ref. 5], and Utterback [Ref. 9] point out the importance of innovation in becoming competitive, but the nature of change that must take place to rapidly improve innovation is not addressed satisfactorily. Schonberger [Ref. 10] proposes "incremental improvements, but they are neither appropriate nor desirable during the periods of technology discontinuities. Monger (1988) strongly points out the lack of management of technology and identifies three problems characterizing the current status of American technology management practices: slow technological absorption, height implementation failure, and avoidance of social consequences. Here our comment is about the payback period of the old technologies. As an example, the communication technology especially in the telephone industry is very developed by digital technology, but American people are not able to use this technology fully because, the current system already has a long payback period. This payback period comes from the usage of the current system. Recovery of the money that had spent for the system from the usage is the payback money. The time that is passing during this recovery process is the payback period. Because of this period the

government is not willing to make another investment to the same area.

The role of government in relation to technological development is categorized by Hawthorne [Ref. 6] as follows:

- **Promotional**, the allocation of resources controlled by the government to support science and technology;
- **Neutral**, in which government aims to maintain the economic and social structure without exerting undue influence on the precise direction of technological development;
- **Regulatory**, in which government endeavors to curb adverse environmental impacts and social distortions caused by technology.

Most governments operate simultaneously in all of these roles and it is, therefore, not surprising that their influence on technology is by no means clear-cut. The interaction is confused by the different time-scales of technological development and political interest and, to complicate matters further, the government's role in respect of any specific technology may change with time. It is, therefore, desirable to consider these roles in the context of different time periods which, for present purposes, are taken as:

- **Long**, about 30 years or more;
- **Medium**, 10 to 15 years;
- **Short**, about 5 years;
- **Emergency**, not strictly a time-period but nevertheless representing a special role which government has always to be prepared to undertake.

The following figure illustrates the relationship between these roles and time-periods by reference to the types of activity through which a government's influence on technological development may be expected to have its major effect.

It shows, for example, the fields in which the government may, by taking action in the present, promote or prevent technological developments the effects of which will be fully experienced at some point in the future. Any activity of government will, of course, have some immediate effect which is usually local in character until the main objectives have been achieved. For example, the development of a commercial aeroplane may initially provide considerable employment for the aircraft and supply manufacturers but neither they nor other industries, nor society feel its full impact until the aircraft is operational. In Figure 1 time period is defined as generally representative of the time taken for the effect of government influence to work through the technological system and to persist until changed.

TIME PERIOD (YEARS)	PROMOTIONAL ROLE	NEUTRAL ROLE	REGULATORY ROLE
30 +	Support of basic science	Assurance of materials resources and supply. Social and economic structural and attitude changes	Control of developments resulting in adverse biological changes.
10-15	Infrastructure systems (transport, communications energy). Advanced technology projects. Applied research. Employment.	Industrial and institutional change. Welfare infrastructure Education.	Long-term health protection. Control environmental developments.

TIME PERIOD (YEARS)	PROMOTIONAL ROLE	NEUTRAL ROLE	REGULATORY ROLE
~5	Product development. Procurement programs. Training.	National planning. trade promotion and control. Employment	Health and safety. Consumer protection. Monitoring (pollution, adverse reactions).
EMERGENCY	Planning emergency procedures. Mobilization of resources.	Financial rescue of projects and firms.	Application of existing law and emergency powers. Trade controls.

III. MANAGEMENT OF TECHNOLOGY AND INNOVATION

A. TECHNOLOGY MANAGEMENT

Successful technological innovation requires a competent management system. We need effective policies to set the right technological creation. Also this policy should support an environment contribution to technological innovation, and set priorities available resources to simplify the development, manufacture, and marketing of new ideas and ventures. It is important to set a technological policy that creates or sets the stage for innovation aspirations, processes, and achievements. Maidique and Patch [Ref. 11] present six major areas of technological policy on which there can be focus:

1. Technology selection, specialization. This provides a clear and certain policy to follow.
2. Improving the level of competence, with an emphasis on basic research, applied research, and development engineering.
3. Sources of technological capability: internal versus external.
4. Research and development investment and staffing.
5. Competitive timing: initiative versus responsiveness.
6. Research and development organization and policies: flexible or structured.

It would seem that one of the most important issue is the management of the innovation and technology. As officers our

main duty is to manage effectively. Especially in our national forces this is more obvious. In military schools we are taught effective management. Although the management of innovation and technology requires some special skills which in fact keep the art of management stays basic. Successful technological innovation requires a competent management system. Effective managers are needed to set the right technological policy for the creation of an environment conducive to technological innovation, and to prioritize available resources to facilitate the development, manufacture, and marketing of new ideas and ventures. Some authors give guidelines for successful innovative managers. According to Edosomvan [Ref. 12] the manager's supportive relationship is characterized by the following:

1. Confidence and trust.
2. Interest in the subordinate's future.
3. Understanding of and desire to help with problems.
4. Training and helping the subordinate to perform better.
5. Teaching subordinates how to solve problems rather than giving the answer.
6. Giving support by making available the required physical resources.
7. Communicating information that subordinates must know to do their job and also the information they wish to know so that they may identify more with the operation.
8. Seeking out and attempting to use ideas and opinions.
9. Approachability.
10. Crediting and recognizing accomplishments.

Also the characterization of the ideal innovative manager should include but not be limited to the following features:

1. Has strong desire for innovative products or services. Wants people to come forward with new ideas and welcomes their implementations.

2. Has strong empathy when dealing with people, and possesses a caring attitude when dealing with the desires and needs of individuals and the organization.

3. Provides and encourages a trustworthy working environment where people can share ideas honestly.

4. Has a high level of creativity and is technically competent. Has a thorough knowledge of the business and has good ideas on how to improve it.

5. Is loyal and supportive of employee contributions and ideas, and works with them to obtain the resources needed for implementing such ideas.

6. Delegates work effectively and gives necessary control to workers to perform their tasks.

7. Accommodates failures, listens effectively, and rewards bad and good behavior in a timely manner.

8. Provides essential guidance when required; provides feedback on performance and monitors key activities effectively.

9. Is innovative and self-confident.

10. Is willing to take risks, pursue new ventures, and encourage subordinates to do the same.

Petersen [Ref. 13] provides some other guidelines for successful managers' performance.

1. Deal with people as human beings, not machines.

2. Lead, do not drive or push.

3. Get people to like and respect you, create loyalty, win cooperation, instill confidence, build morale, and make people feel that they belong.

4. Listen to grievances.

5. Give credit when due, and time it psychologically.

6. Explain changes in advance.

7. Give orders clearly and precisely.

8. Ask for opinions and suggestions.

9. Be patient and impartial, consistent, friendly and courteous.

10. Display personal interest in the home life, hobbies, avocations, recreation, and personal problems of your workers.

11. Do not argue or be dogmatic when you disagree.

12. Get to know your own personal characteristics so as to avoid irritating or antagonizing others.

13. Get to know the personal characteristics, likes, dislikes, whimsies, convictions, idiosyncrasies, and motivating qualities and fundamental instincts of your workers.

14. Same as above for your boss, so as to enable you to get along with him.

15. Recognize your responsibilities to both management and labor.

16. Run your department as a business.

17. Find out what the workers really want most.

18. Test your subordinates to check attitude and ability.

19. Maintain a personal history record of each employee.

20. Put the "team" and competitive spirit to work.

21. Learn to recognize symptoms of trouble.

22. Correct misdemeanors only when a person has cooled off.

23. Anticipate difficulties and remove obstacles in advance; plan ahead and organize.

24. Interest the workers in the quality of production.

25. Keep in sound physical health and develop a saving sense of humor.

Technology and innovation management require an integrated process that is consistent with both management and employees with the ultimate goal of managing the invention, design, development, production and the use of various forms of technology in practical life. An effective management of technology requires the management of both positive and negative effects of technology.

Waterman, Jr. [Ref. 14] defines management of technology (MOT) as follows:

> "Management of technology is an industrial activity and an emerging field of education and research that is not generally well recognized or even consistently defined. It *concerns the process of managing* technology development, implementation and diffusion in industrial or governmental organizations. In addition to managing the process through R&D, it includes managing the introduction and use of innovation and in other corporate functions. technology in products, in manufacturing processes, and in other corporate functions."

According to Waterman,Jr. [Ref. 14]:

Management of technology links engineering, science, and management disciplines to plan, develop, and implement technological capabilities to shape and accomplish the strategic and operational objectives of an organization.

At this point Edosomwan's 6C principles give us a good way of understanding the management of technology.

The 6C principles for managing technology and research and development projects:

1. Provide Controls.
2. Provide a Focal Point For Coordination.
3. Provide Adequate Communication Channels.
4. Provide Adequate Focus on Cost Avoidance.
5. Implement Measures to Analyze the Contribution of Each Phase.
6. Facilitate Cooperation among project Participants.

B. DIFFUSION AND ADOPTION OF INNOVATIONS

As we stated earlier the most important step in Roger's Innovation-development process was "Adoption and Diffusion". It is very important because to adopt a new idea even when it is desirable to everybody, is often very difficult. Many innovations require a long period from their first availability until their wide adoption phrase. The important point here is how to speed up the level of diffusion of an innovation.

First of all we will give a definition of diffusion. Rogers defines diffusion as; "The process by which an innovation is communicated through certain channels over time among the members of a social system." This is a special type of communication, in that the messages are concerned with new

ideas. Communication is a process in which participants create and share information with one another in order to reach a mutual understanding. Diffusion is a kind of social change, which alteration occurs in the structure and function of a social system. Especially in organizations like DoD this communication process becomes more important and hard to coordinate. So the problems in the diffusion process increase as organization levels.

Rogers gives us four main elements in the diffusion process;

1. **Innovation**

Earlier in the second chapter we gave some definitions about the nature of innovation. Here the issue given by Rogers [Ref. 1] is the importance of the characteristics of innovations. When we try to explain different rate of adoption by individuals these characteristics help us. Similarly when choosing change agents for a diffusion project these characteristics must be acknowledged.

Characteristics of Innovations

- Relative Advantage. This is the degree to which an innovation is perceived as better than the idea it displaces.
- Compatibility. The degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters.
- Complexity. The degree to which an innovation is perceived as difficult to, understand and use.Some innovations are easily understood by the members of social a level because of their simplicity. But some of them take time to adopt

because of they require the adopter to develop new skills and understanding.

- Trialability. The degree to which an innovation may be experimented with on a limited basis.
- Observability. The degree to which the results of an innovation are visible to others.The easier it is for individuals to see the results of innovation, the more likely they are to adopt.

2. Communication Channels

A communication channel is the means by which messages get from one individual to another. These channels include tv, radio, press, gossip etc. The nature of information-exchange relationships between the pair of individuals determines the conditions under which source will or not transmit the innovation on a particular channel to the receiver, and the effect it has upon the success of the transfer.

3. Time

Time is an obvious aspect of any communication process. It is an important element in the diffusion process. An innovation's rate of adoption in a system, usually measured as the number of members of the system that adopt the innovation in a given time period.

4. Social System

This system is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The structure of the social system totally effect the nature of innovations. Also It is important to understand that the diffusion process takes place in that social system.

C. ORGANIZATIONS

Technological innovation in and among organizations has been a "hot" topic for quite some time. The degree of adoption among people or organizations is often described with the term "diffusion." We are primarily concerned with innovation as adoption of new products and processes that reflect the application of information technology, simply new technology.

It has been particularly this diffusion of technology that has been a topic of interest among organizational researchers and managers. It has been studied in many different areas such as manufacturing, customer service, product development, medical research, industrial and labor relations, corporate strategy, and management information systems. Scholars are interested in such questions as to what impedes or enhances the adoption of applications, who are the early adopters, what kinds of applications are more difficult to adopt, and who are the critical participants in the adoption process? Adoption of innovation by organizations is also of special interest because much of the diffusion literature has dealt with diffusion among individuals; diffusion among organizations presents special challenges because, unlike individuals, they are complex human aggregates with various decision centers and are endowed with traditions, values, and procedures that impede or enhance the decision adoption process.

IV. INNOVATIONS IN ORGANIZATIONS

In the previous chapters, the nature and processes of innovation have been discussed. In this chapter, we discuss innovation processes in organizations, specifically public organizations. The main purpose of this chapter is to identify the hypotheses in examining innovation processes in organizations. In identifying these hypotheses, we first define the organization concept and present an open systems model of organization. Based on this model, we examine the human element of organizational environment as it relates to innovation processes. Then we discuss specific characteristics of public organizations. Finally, we bring together all the hypotheses at the end of the chapter. The observations on these hypotheses are later presented in chapter V.

A. ORGANIZATION CONCEPT

The concept of organization has been defined in a variety of ways. There are several approaches in dealing with organizations. Classical organization theory emphasizes principles while assuming a relatively stable and predictable environment. The behavioral school stresses social needs and in general, focuses on human motivation. The quantitative school introduces mathematical techniques to the organization concept. [Ref. 15]

Rogers defines organization as "a stable system of individuals who work together to achieve common goals through a hierarchy of ranks and a division of labor." [Ref. 1:p. 348] Organizations are a necessary element of our life. They enable us to accomplish things that we could not do as individuals; they serve society; they help provide a continuity of knowledge; and finally, they serve as an important source of careers [Ref. 15]. They are created to handle routine tasks and to lend stability, which stems from the relatively high degree of structure that is imposed on communication patterns. A stable and predictable organizational structure is obtained through:

1. Predetermined goals. Organizations are formally established to achieve certain predetermined goals. These goals determine to a large extent the structure and the function of the organization.

2. Prescribed roles. Organizational tasks are distributed among the various positions as prescribed roles or duties. The roles and positions continue regardless of the changes in people.

3. Authority Structure. Positions are organized in a hierarchical authority structure that specifies who is responsible to whom.

4. Rules and regulations. A formal, established system of rules and regulations governs decision making among organizational members.

5. Informal patterns. Every formal organization is characterized by various kinds of informal practices, norms, and social relationships among its members [Ref. 1:p. 349].

Rogers' approach brings together the important parts of different theories that are stated above. While these

approaches are useful in studying organizations, they lack an overall view of the concept. For our purpose, we will use the systems approach to view the organization.

B. THE OPEN SYSTEMS MODEL OF ORGANIZATIONS

The *systems approach* attempts to view the organization as a unified, purposeful system composed of interrelated parts. Rather than dealing separately with the various segments of an organization, the systems approach views an organization as a

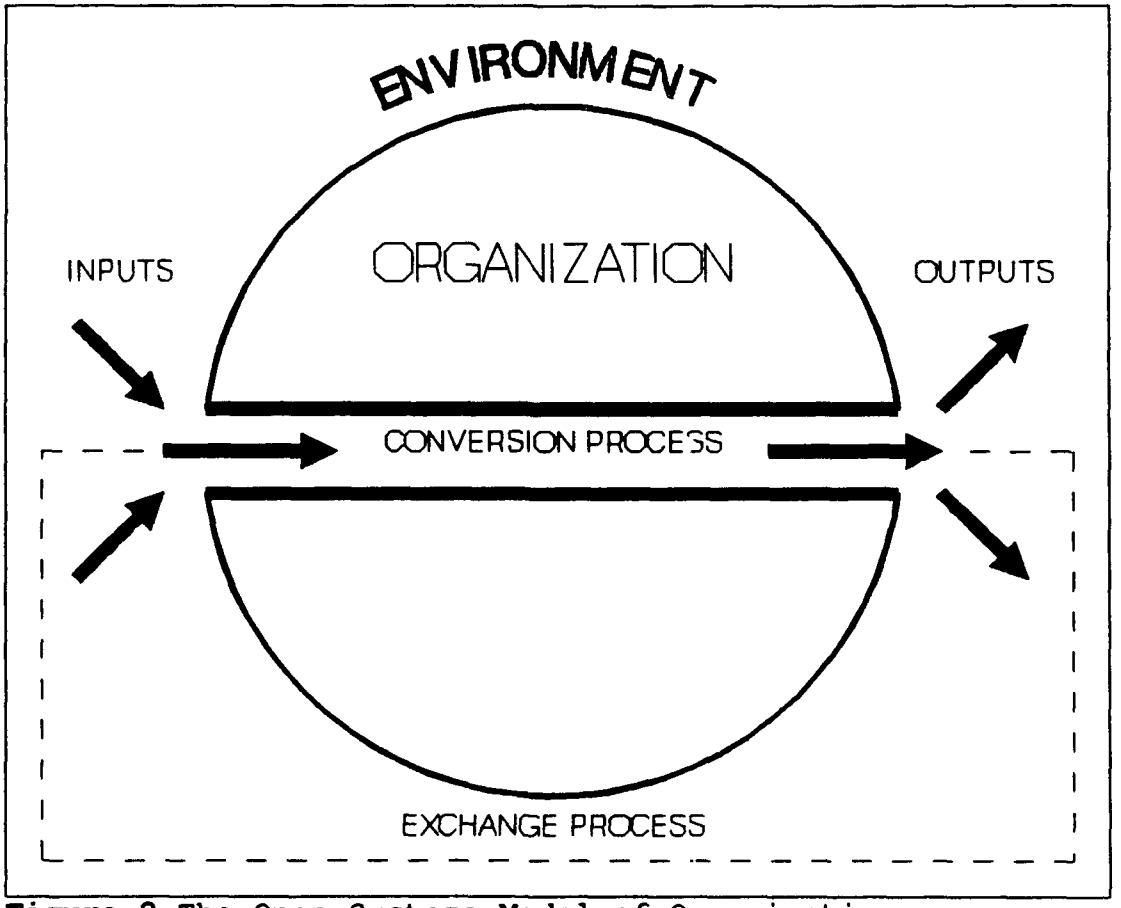

Figure 2 The Open Systems Model of Organizations.

whole and as a part of the larger, external environment [Ref. 15:p. 56]. A system is considered an *open system* if it interacts with its environment. Since all organizations interact with their environments to some extent, it is possible to view organizations as an open system.

Almost all of the organizational studies distinguish organizational environments as external and internal. For our purpose, it is not necessary to make such a distinction. We define organizational environment as the totality of physical and social factors that are taken directly or indirectly into consideration in the decision-making behavior of individuals in the organization. This total environment consists of direct-action and indirect-action elements. Direct-action elements are the elements of the environment that directly influence an organization's activities. These are stakeholder groups such as customers, suppliers, competitors, regulatory bodies, special interest groups, media, and employees. Indirect-action elements are the elements of the environment which affect the climate in which an organization's activities take place. These are social, economic, political, and technological variables which affect the organization indirectly.

There are certain implications of the open systems model:

1. The organization depends upon its environment for resources and acceptance of its outputs.The organization is a subsystem of its environment, must meet the needs of the larger system to survive.The organization must adapt to changes in its environment.

2. Organizational survival depends upon events both internal and external to the organization.

The term "organizational survival" deserves special attention. When we establish the organizational goals according to a time frame, we see that "survival" is the only long-term goal of an organization:

1. Short-term goals: Production, efficiency, morale, environmental support.
2. Intermediate goals: Adaptiveness, development.
3. Long-term goal: Survival.

The open systems model of organizations provides a useful framework to study innovations in organizations. Its implications are very important for determining organizational innovation processes. Based on this model, we present the following hypotheses:

1. Organizations will innovate to attain their goals.
2. The underlying reason for the most radical innovations in an organization is to assure its survival.
3. Most innovations in organizations will be imposed by its external environment.

C. HUMAN FACTOR IN ORGANIZATIONAL ENVIRONMENT

Organizations are created and managed by people. In the previous section, we listed various environmental elements which affect directly or indirectly the organization's activities. The human factor is not stated on that list, but it underlies all those elements. In an organizational context, we refer to the human factor by using the word professionals.

It is important to keep in mind that, strictly speaking, professions and professionals are not only an internal component of an organization, but belong to the total environment.

Understanding the organizational innovation process requires an understanding of the role of professionals in this process. All innovations are initiated, adopted, or resisted by the people in the organization. Our view of organizational innovation process, to a large extent, depends on the way we view professionals.

There are two different approaches to the professions and professionals: structural-functional and radical-structural. The two perspectives differ markedly in (1) how social structure of professions are viewed; (2) the values and motivations believed to be held by the profession and professionals; (3) how innovations are conceptualized; and (4) the major hypotheses and methods of research. Those differences are summarized in the next two sections. [Ref. 16]

1. The Structural-Functional Perspective

This perspective views a profession as a homogeneous community, marked by adherence to the collectively shared set of values, norms, orientations and interests of that profession. Professionals are seen as structural components of a highly differentiated society and they contribute

functionally to the fulfillment of system needs or goals. According to this perspective, professionals are not motivated by money, status, and power. They have certain professional values. These are: (1) Autonomy in work, (2) a belief in professional growth as the measure of success, (3) an acceptance of peer evaluation, rather than the opinion of a 'superior', and (4) an assignment of the highest value to the activities that develop new knowledge. These professional values and the professional exposure to external information are the main motivations for professionals to innovate. In dealing with innovations, this approach focuses on assessing the level of professional contribution to organizational adaptiveness, and treats them as a set of aggregated innovations.

The reasoning of this approach leads to the following major hypotheses regarding professionals and innovations:

1. The greater the cosmopolitanism of the individual professional, the greater the number of innovations adopted by the organization.
2. The more professional the organizational staff, the more innovative the organization.
3. The more occupational specialties employed by the organization, the more innovative the organization.

2. The Radical-Structural Approach

The radical-structural approach views professions as internally differentiated, consisting of multiple communities or segments that participate in a wide variety of tasks and

activities, and that adhere to correspondingly diverse communal systems of norms and values. According to this perspective, underlying motivations of professionals are primarily ones of power, status, and control over a knowledge domain. The conflict of interest that accompanies professional differentiation has significant consequences for innovation process. Innovation is seen as a political act, invoked by professionals to advance, maintain or defend their claims to legitimate control over a technical domain. Thus innovation is a major arena where political power within and between professions is played out. Innovations themselves require different treatment from that used by the first approach. The focus here is on determining the differential support a specific innovation will receive from conflicting professional segments. This focus leads us to seek an understanding of the fate of individual innovations, as opposed to a set of aggregated innovations.

The major hypotheses of this approach are as follows:

1. Members of a professional segment will develop and support only innovations that advance their power and control over a professional segment.

2. Members of a professional segment will resist innovations supported by competing segments, other professions, para-professional groups, or bureaucrats to the extent that the innovation reduces their power and control over a professional domain.

3. The ultimate success and pattern of the diffusion of an innovation will depend on the power of the competing groups and the clients' acceptance of the professed arguments.

3. Synthesis

Each one of these approaches offers quite different perspectives on the role of professionals in the innovation process in organizations. We believe that neither approach gives a complete answer on this question of the role of the professionals in the innovation process.

> "The motivational basis of the structural-functional argument is that professionals have instutionalized the values of their profession, especially with respect to the growth of knowledge through technology and innovation. To ignore these values, their legitimating role and grounding in conflicting bases of knowledge, would constitute 'vulgar materialism'. However, to ignore career interests, which radical structuralism emphasizes, and the examination of the conditions under which professionals use, or ignore, or distort, their values for personal gain would constitute 'vulgar idealism." [Ref. 16:p. 258]

We believe both of these approaches are useful in understanding the professionals' role in the innovation process. We cannot accept one and ignore the other. We have to be aware of both approaches and test their hypotheses in examining real world examples. We have to consider both of them in predicting the future of certain organizational innovations.

D. PUBLIC ORGANIZATIONS

The main focus of this thesis is not the organizations in general, but specifically public organizations. Our real life example of the organization is a public organization and we

will make observations on this example regarding to our hypotheses. It is important to consider specific characteristics of public organizations as they relate to the innovation process.

1. Characteristics of Public Organizations

It is not necessary or reasonable to argue that public organizations and public services management possess fully unique characteristics and contexts that require a completely different approach from private ones. Not all organization forms fall easily into a two-fold classification of 'fully private' or 'public'. Rather a continuum between these extremes can be posited. Furthermore it is possible to demonstrate some close parallels between some large private firms and public organizations. Nevertheless, it is important to establish that, especially for public organizations, there are important dissimilarities between the contexts, both inner and outer, and pressures upon public and private organizations.

Differences in contexts and pressures may be considered in terms of environment, organizational and environmental transactions, and internal structures and procedures. Public organizations face less market exposure and more formal constraints than their private counterparts. External informal influences on them are more diverse and intense. They also experience greater public expectations of

integrity of actions and scrutiny on those actions, and greater vagueness and intangibility of objectives. Public organizations tend to be distinguished by both high labor intensity and high professionalization. These and other major differences are summarized as follows: [Ref. 17]

Public Organizations:

1. Statutory and parliamentary regulation; codes of conduct.
2. Needs of National Economic management.
3. Relative openness of government and decision-making; stress on representatives.
4. Attentive publics; wide stakeholder base.
5. Multiple values and goals.
6. Primary resource base from public taxes.
7. Extensive accountability.
8. Responsiveness to political masters and short political time-horizons.
9. Primary social goals.
10. Complex and debated performance indicators.
11. More ill-defined policy directives; complexity of policy implementations.

Private Organizations:

1. Board of directors; company planning frameworks.
2. Marketplace signals.
3. Relative secrecy; stress on business confidentiality.
4. Primary focus on shareholders.
5. Relatively restricted values and goals.
6. From operational returns and borrowing.

7. Restricted accountability.

8. No real national/local politician overlay; less time constraints.

9. Primary profit goals.

10. Mainly quantitative financial measures.

11. Relatively less ambiguous policy.

2. Innovation in Public Organizations

These differences between public and private organizations suggest that public organizations are more inflexible and bureaucratic. There is a stereotype view of public organizations as bureaucratic and inflexible. Innovation in public organizations is particularly important, because it is the antidote to flexibility.

> "In some respects innovation is more difficult in public organizations. According to Roessner, the public organization's reliance on extrinsic rewards and the absence of direct incentives for innovation can serve as important barriers to change. Property rights theory argues further that innovation will be uncommon in public organizations because work activity does not revolve around a common concern with improved technical efficiency but, instead, around side payments that relate more to personal aggrandizement." [Ref. 18]

There are also other arguments indicating the difficulty to innovate in public organizations. Almost all of these arguments are based on the innovation studies done on private organizations. Those studies identify attributes of organizational innovations. When they look at the public organizations, they cannot find most of these attributes, such

as reward structure, slack resources, and they reach this conclusion. But despite the arguments that environment, structure, and procedures of public organizations create an unfavorable environment for innovations, public organizations have had successes in fostering innovation. This implies that the innovation process in public organizations should be examined differently than in the private organization. We should identify other attributes of innovation, which will help us understand the innovation process in public organizations.

We think differences between public and private organizations when considered together with the human factors explained above, give us basic assumptions for the innovation process in public organizations. We brought together these assumptions in our hypotheses.

E. HYPOTHESES

The open systems model of organizations, coupled with human factors leads us to the following hypotheses related to the innovation processes in public organizations:

1. The underlying reason for the most radical innovations in an organization is to assure its survival.
2. Although generally resistant to change, most of the time, public organizations will accept innovations that are imposed to them by their environment.
3. Professional segments within and outside the public organization will play a significant role in the innovation process.

4. Underlying reason for the role played by professionals may be both professional values, eagerness to contribute to the profession and considerations of power and control.

5. The ultimate success and pattern of the diffusion of an innovation will depend on the power of the competing groups and the clients' acceptance of the professed arguments.

The observations of the workings of these hypotheses in the innovation processes in the Department of Defense are presented in the following chapter.

V. OBSERVATIONS ON DOD

This chapter presents our observations on the innovation processes in Department of Defense. Those observations are in line with the hypotheses developed in the previous chapter. In the first part, our approach in making those observations is explained and in the second part, the observations are presented.

A. APPROACH IN MAKING OBSERVATIONS

1. Organization

Before examining innovation processes in an organization, we have to have a clear understanding of this specific organization and its environment. Rogers defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system [Ref. 1:p. 5]. In this definition, the term social system is what we call an organization and its environment. Rogers also gives the definition of social system:

> "A social system is defined as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems." [Ref. 1:p. 24].

Innovations and their diffusion occur within a social system. A social system has critical importance to the

innovation process. The structure, norms and many other characteristics of a social system can facilitate or impede the creation and diffusion of innovations.

When we are talking about organizations, we are talking about social systems. The organizations are social systems that are subsystems of larger social systems, and they also consist of several subsystems. Innovation processes in a social system are affected by its structur' norms, attitudes and approaches. These processes are also largely dependent on the interactions of different social systems.

In examining innovation processes in DoD we use the framework represented in Fig. 3 as a conceptual representation of the social system of DoD. This social system covers not only the organization of DoD and its subsystems, but also the other social systems which affect the innovation processes.

DoD as an organization consists of several subsystems. Services with their own acquisition organizations and research labs, Signified and unified commands, Defense Advanced Research Programs Agency, and Strategic Defense Initiative. All these subsystems also consist of several different subsystems. Immediate social systems that interact with the DoD are the executive and legislative branches. Executive branch consists of the Office of the President and all other departments. Legislative branch is the congress. We identify two other social systems which directly interact with DoD in innovation processes: Industry and Universities. It is

important to keep in mind that there is a very dynamic interaction between all these social systems, and this interaction has critical importance on innovation processes. All these social systems are also interacts with the larger world environment so, we put the world as a whole with the allies and threats as the large social system.

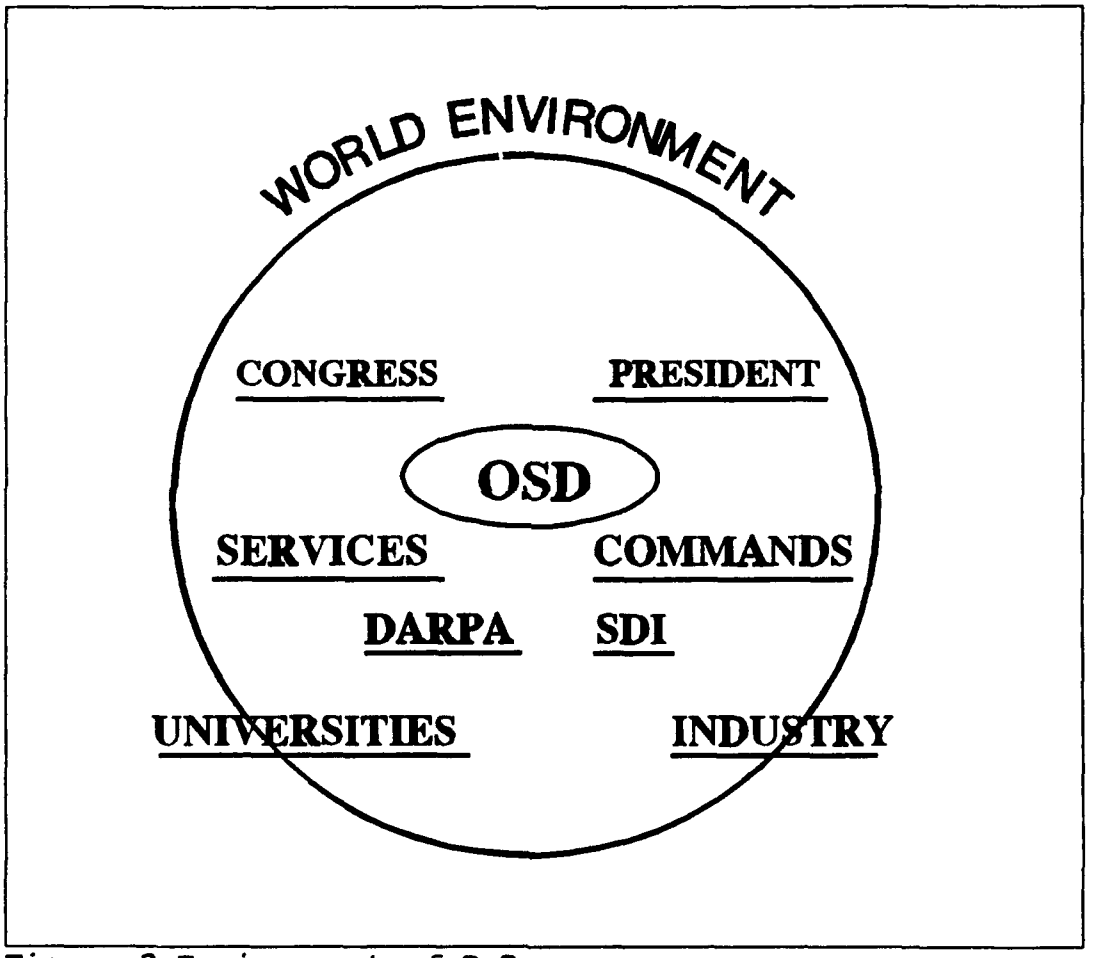

Figure 3 Environment of DoD

2. Innovations

Another point to be identified is which innovations specifically we are examining. Our main focus on the technological innovations in weapons development. There are two important reasons for this: First, we are mainly interested in technological innovations. Second, the weapons acquisition process is the central activity of DoD. It is directly related with the goal of the organization. Strategies developed by different subsystems in the organization can only be achieved by supporting weapons acquisition programs. It involves resource allocation decisions within the organization, and always under scrunity of other social systems. Innovations in this process have also serious consequences for the other activities of this organization.

3. Process

Our observations on the innovation process in the Department of Defense is based on a literature research. We conducted a search of the literature on DoD's weapon strategy development and weapons acquisition process. This research included the books, periodicals, congressional reports, and the reports prepared by several components of DoD. A selected listing of the literature examined is given in Bibliography. The literature presented in this bibliography is itself revealing with regard to the dynamics of the innovation process in the U.S. Department of Defense.

In this research, we traced the evidence that is supporting our hypotheses. Although this approach is not sufficient to test empirically the hypotheses, we believe this kind of approach is adequate within the scope of this study.

B. EVIDENCES

The evidences which support our hypotheses are presented in this section for each one of the hypotheses.

1. The Role of Professional Segments

- Professional segments within and outside the public organization will play a significant role in the innovation process.
- Underlying reason for the role played by professionals may be both professional values, eagerness to contribute to the profession and considerations of power and control.

The diversity and the variety of the literature on Department of Defense is itself a satisfactory evidence for these hypothesis.

2. The Role of The Environment

- Although generally resistant to change, most of the time, public organizations will accept innovations that are imposed to them by their environment.

Again, there is considerable evidence that the immediate environment of DoD imposes innovations on this organization. In this process, the critical factor is the relationship of DoD with the part of the environment that forces it to innovate. This relationship is the decisive factor on DoD's reaction and on the success of the innovation.

3. Organizational Survival

- The underlying reason for the most radical innovations in an organization is to assure its survival.

This is a controversial issue, which is frequently brought up in various publications.

4. The Success of Diffusion

- The ultimate success and pattern of the diffusion of an innovation will depend on the power of the competing groups and the clients' acceptance of the professed arguments.

There are several cases which support this hypotheses. Nevertheless, further research should be done on this particular hypothesis.

VI. CONCLUSION

A. OVERVIEW

This research was undertaken to study innovation process in organizations. The main objective was to provide insight on the dynamics of the innovation process in organizations, which will help us construct a new perspective and framework in managing innovations within organizations.

The interaction between technology and innovations, management of technological innovations, and innovation processes specific to the public organizations are explored. The hypotheses on innovation processes in organizations are developed. The evidence supporting these hypotheses are presented by observations on the innovation processes in the U.S. Department of Defense.

The thesis concluded by presenting conclusions and suggestions for further research

B. ANSWERS TO RESEARCH QUESTIONS

Responses to the subsidiary research questions will be summarized culminating with the principal research question.

Subsidiary Research Question 1. What are the characteristics of innovation process? The innovation process has an evolutionary nature. This is the most important characteristic of all innovations in general. There are other

characteristics, which have an impact on the diffusion and adoption of innovations. These are relative advantage, compatibility, complexity, trialibility and observability.

Subsidiary Research Question 2. What is the importance of relation between technology and innovations? The terms 'technology' and 'innovation' are generally used interchangeably. But the term 'technology' has much broader meaning than the term 'innovation.' In short, technology is a series of actions that deliver an innovation.

Subsidiary Research Question 3. What are the considerations in managing technological innovations? The first and the most important consideration is establishing an effective policy. The second consideration is setting the priorities appropriately.

Subsidiary Research Question 4. What are the driving forces for innovations? In organizational level, driving forces for innovations are identified in our hypotheses. The simple answer to the question "Why do we innovate?" may be "To satisfy our needs." But there is more to the innovation process. Sometimes 'desires' or 'personal/professional satisfaction' play a dominant role. Most of the times, we innovate because we have to. Our environment dictates innovations to us.

Subsidiary Research Question 5. What are the role of organizational environment in innovation process? Organizational environment, either internal or external plays

a very significant role in the innovation process. From generation of innovations to their diffusion and adoption, Several parts of the environment of the organization, which have a stake on the organization itself or on the success of the innovation, take an active role in the process. Most of the time the fate of the innovation depends on the relative power of these environmental parts.

Primary Research Question. What are the main determinants of the innovation process in public organizations? Our hypotheses identify four main determinants of the innovation process in public organizations. First, public organizations will innovate when their very existence in danger. They will be ready for the most radical innovations to assure their survival. Second, when they seem to become static, public organizations will likely to be exposed to the environmental pressure to innovate. Third, Professional segments are an important determinant of the innovations in organization. The ultimate success and pattern of the diffusion of an innovation in a public organization will depend on the relative power of these segments.

C. SUGGESTIONS FOR FURTHER RESEARCH

This research mainly focused on developing hypotheses with regard to the innovation processes in public organizations. There is a need for an extensive empirical research to test these hypotheses.

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7.	Kara Harp Okulu Ogretim Kurulu Bakanliklar\Ankara\Turkey	1
8.	Prof. R.A. McGonigal NPS Code AS/Mb Monterey CA 93943	1
9.	Seckin Durmaz Devlet Yolu Üstü 30/14 Karamürsel/Kocaeli\Turkey	2
10.	Ahmet Can Cevik Dr. Kemal Köseoğlu Eliyle Karyağdi sok. 26/5 Cankaya\Ankara\Turkey	2